

## Asymmetries in grammar



Day 1: Language, cognition and optimality

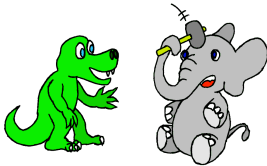
Petra Hendriks, LOT Winter School 2009

## Language, cognition and optimality

- Delay of Principle B Effect
- Previous explanations of the DPBE
- Basics of Optimality Theory (OT)
- Optimality and cognition
- Illustration: Sentence generation, interpretation, DPBE
- Overview rest of course

Here you see an elephant and an alligator.

The elephant is hitting himself.

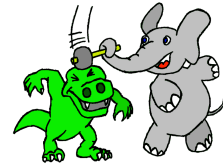


Does the sentence match the picture?

Children: YES

Here you see an elephant and an alligator.

The elephant is hitting himself.

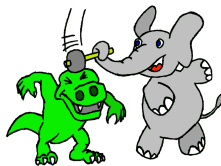


Does the sentence match the picture?

Children: NO

Here you see an elephant and an alligator.

The elephant is hitting him.

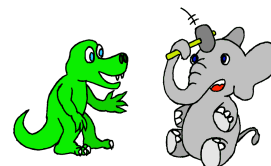


Does the sentence match the picture?

Children: YES

Here you see an elephant and an alligator.

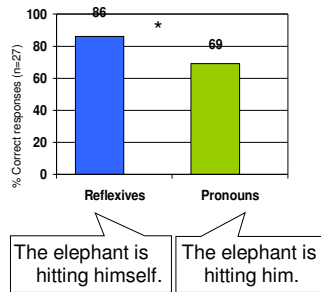
The elephant is hitting him.



Does the sentence match the picture?

Children: YES !

## Comprehension in 4- to 6-year-olds

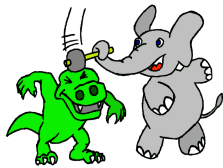


(Spencer, Smits & Hendriks, 2009)

## Binding Theory

- Binding Theory (Chomsky, 1981):
  - Principle A: Reflexives must be locally bound.
  - Principle B: Pronouns must be locally free.
- Apparently, these children do have knowledge of Principle A, but have no knowledge of Principle B.

Here you see an elephant and an alligator.

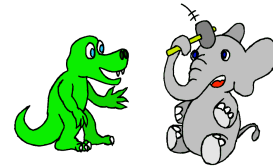


What is happening in the picture?

Children:

The elephant is hitting him.

Here you see an elephant and an alligator.

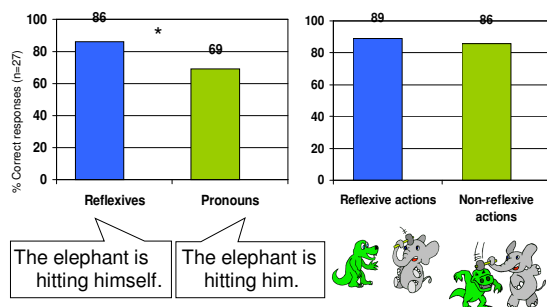


What is happening in the picture?

Children:

The elephant is hitting himself.

## Comprehension Production



(Spencer, Smits & Hendriks, 2009)

## Production/comprehension asymmetry

- Delay of Principle B Effect in comprehension until 6 years old.
  - (e.g., Jakubowicz, 1984; Chien & Wexler, 1990; Grimshaw & Rosen, 1990, for English; Deutsch, Koster & Koster, 1986; Koster, 1993; Philip & Coopmans, 1996, for Dutch)
- However, children's production is adult-like from age 4;6 on.
  - (de Villiers, Cahillane & Altreuter, 2006, for English; Spencer, Smits & Hendriks, 2009, for Dutch)

## DPBE across tasks

- Truth Value Judgment Task / Picture Verification Task  
(e.g., Chien & Wexler, 1990; de Villiers, Cahillane & Altreuter, 2006; Grimshaw & Rosen, 1990; Spenader, Smits & Hendriks, 2009)
- Picture Selection Task  
(e.g., Deutsch, Koster & Koster, 1986; Koster, 1993)
- Act Out Task  
(e.g., Chien & Wexler, 1990; Jakubowicz, 1984)

## Production precedes comprehension

- In production, children seem to use knowledge of Principle B.
- So why don't these children use their knowledge of Principle B in comprehension?



## Issues arising from the existence of asymmetries

- Relation between production and comprehension
- Organization of the grammar
- Nature of linguistic knowledge
- Types of linguistic evidence
- Competence vs. performance
- Relation between grammar and other cognitive domains

## Previous explanations of DPBE (1)

### Lack of relevant pragmatic knowledge:

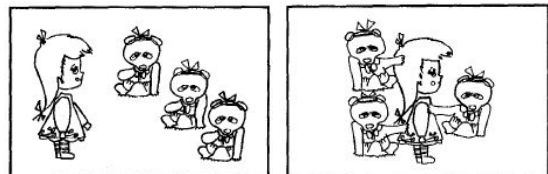
- (e.g., Chien & Wexler, 1990; Thornton & Wexler, 1999)
- Children have knowledge of Principle A and Principle B.
- Coreference  $\neq$  variable binding:
  - The elephant<sub>i</sub> is hitting him<sub>i</sub>
- Children do not yet possess the pragmatic knowledge required to rule out accidental coreference.

## Quantificational Asymmetry

- Children do not allow bound interpretation with quantificational subjects (C&W, Exp. 4):
  - Mama bear<sub>i</sub> washed her<sub>i</sub>
  - Every bear<sub>i</sub> washed her<sub>i</sub>
- Has been used as argument for children's knowledge of Principle B.
- However, salience is confounding factor (Elbourne, 2005; Conroy, Takahashi, Lidz & Phillips, ms)

## Chien & Wexler (1990)

- These are the bears; this is Goldilocks. Is every bear touching her?



- Goldilocks is much more salient than the three bears.

## Previous explanations of DPBE (2)

### Experimental artifact:

(e.g., Bloom, Barss, Nicol & Conway, 1994; Grimshaw & Rosen, 1990; Conroy, Takahashi, Lidz & Phillips, ms.)

- Children have knowledge of Principle A and Principle B.
- But due to task factors their knowledge of Principle B is underestimated,
- and/or their knowledge of Principle A is overestimated.

## Requirements TVJT

Conroy et al.: Need to balance the relative accessibility of the interpretations under investigation:

- Both coreferential and disjoint referent should be available.
- Both propositions should be under consideration (cf. Crain & Thornton's (1998) Condition of Plausible Dissent).

## Conroy et al.: The Painting Story

- Characters: Hiking Smurf, Tennis Smurf, Papa Smurf [collectively Smurfs], Grumpy, Dopey, Happy [collectively dwarves]
- Papa Smurf announces that Snow White is going to have a party, and that she is going to have a painting contest. Papa Smurf declares that he is going to be the judge. Each of the dwarves shows and discusses the color of paint that he is going to use to get painted, as does Tennis Smurf. However, Hiking Smurf does not have any paint, and he wonders whether one of the other characters will be willing to share. He first approaches Happy, who says that he would be glad to help out if any paint remains after he is painted. Fortunately, when Happy is finished some paint remains, and so he paints Hiking Smurf. Hiking Smurf, however, is not yet satisfied, so he approaches Dopey with a similar request, which is similarly successful. Then, Grumpy, who is in such a bad mood that he does not even want to go to the party, declares that he doesn't need to get painted. The other dwarves really want him to go, and Grumpy agrees to get painted, using all of his paint in the process. After Grumpy is painted, Hiking Smurf approaches him and asks for some paint. Grumpy politely apologizes that he would like to help but cannot, because he has used up all of his paint. Hiking Smurf realizes that his best remaining chance is to ask Tennis Smurf for some extra paint, and Tennis Smurf obliges when he is asked. Finally, everybody is ready for Snow White's party.
- Referential Lead-in: OK, this was a story about painting. Hiking Smurf didn't have any paint, and Grumpy almost didn't go to the party. Let me see ... I think ...
- Test sentence: **Grumpy painted him.**

## Previous explanations of DPBE (3)

### Lack of sufficient processing resources:

(e.g., Avrutin, 1999; Baauw, 2008; Reinhart, 2006)

- Children have knowledge of Principle A and Principle B.
- Reinhart: The interpretation of pronouns requires the parser to perform the additional process of reference-set computation.
- Because of working memory limitations, children are unable to complete this process, resulting in guessing behavior.

## Working memory

- When children's working memory increases, they will be able to complete the process of reference-set computation.

## Proposed explanation of DPBE

### Direction-sensitive grammar:

(Hendriks & Spenader, 2004, 2005/6)

- Children have knowledge of Principle A, but Principle B is not part of grammar.
- Partly different knowledge applies in production and comprehension, resulting in asymmetries.
- ➔ Grammar must be constraint-based rather than rule-based

## Grammar and optimality

Optimality Theory (Prince and Smolensky, 1993/2004):

- Grammar consists of a set of violable constraints.
- Constraints differ in strength.
- Optimal output is candidate that best satisfies constraints (is maximally harmonic).
- Only optimal output is realized.

## Constraints may be in conflict



## Optimality Theory

Input:

/pata/

GEN

Candidate set: [p.ata], [pa.ta], [pat.a], [a.ta], [pa.tap], etc.

EVAL (based on CON)

Output:

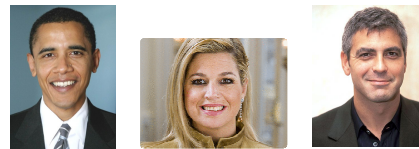
[pa.ta]

## Optimality and cognition (1)

Optimization processes are highly pervasive in biological systems.

They often involve the interaction of different types of information.

- Example: Recognizing faces



## Optimality and cognition (2)

Contextual information is often crucial:

- Example: Recognizing letters



## Optimality and cognition (2)

Contextual information is often crucial:

- Example: Recognizing letters



S R O T      D E B T      E I S H

## Optimality and cognition (3)

The different types of information may conflict:

- Example: McGurk effect

→ Can be modeled as optimization over set of linguistic constraints (Boersma, 2006).

## Examples of linguistic constraints

- Onset: All syllables have an onset.
- NoCoda: A syllable has no coda.
- Subject: All clauses have a subject.
- Parse: Every element in the input must be expressed in the output.
- Fill: Every element in the output must be present in the input.
- Full-Interpretation: All constituents in the sentence contribute to the interpretation.

## Types of constraints

- **Markedness** constraints: Punish particular outputs, irrespective of the input.
  - Promote economy.
- **Faithfulness** constraints: Preserve distinctions from the input in the output.
  - In syntax and semantics: no identity, but rather mapping between distinction in form and distinction in meaning.
- Markedness and Faithfulness constraints are often in conflict.

## OT syntax

Input:	MARK	FAITH	Input:	FAITH	MARK
p: Raining	Subject	Full-Int.	p: Raining	Full-Int.	Subject
It is raining. Is raining.		*	EXPL piove. Piove.	*!	*

*Tableau 1:*  
Sentences in English

*Tableau 2:*  
Sentences in Italian

(Cf. Grimshaw & Samek-Lodovici, 1998)

## Two directions of optimization



- Production: From input meaning to optimal form.

→ OT syntax



- Comprehension: From input form to optimal meaning.

→ OT semantics

## OT semantics

Interpretation in context:

- Six candidates were invited for an interview. Three were rejected.
  - Three of what?
- Six candidates were hired. Three were rejected.
  - Three of what?

(Hendriks & de Hoop, 2001)

## Anaphoric interpretation preferred

DOAP: Do not overlook anaphoric possibilities (cf. Williams, 1997).

- Six candidates were hired. Three were rejected.
- ➔ Three = three candidates (not 'others').

## Maximize anaphoricity

Forward Directionality: The antecedent of an incomplete NP is the set  $A \cap B$  of the preceding sentence.

- Six candidates were invited for an interview. Three were rejected.
- ➔ Three = three of the candidates invited for an interview (not 'others' & not 'other candidates')

## Avoid inconsistencies

Why do we not always maximize anaphoricity?

- Six candidates were hired. Three were rejected.
- ➔ Three  $\neq$  three of the candidates who were hired.
- \*Inconsistencies: Avoid inconsistent interpretations.

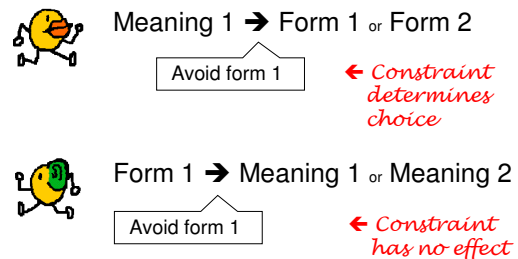
## Optimization of interpretation

Input:	MARK	FAITH	FAITH
Six candidates were hired. Three were rejected.	*Incons.	Forw. Dir.	DOAP
Three of the candidates hired were rejected.	*!		
Three candidates were rejected.		*	
Three non-candidates were rejected.		*	*!

## Rules vs. constraints

- Rules:
    - Form x has meaning y.
    - Example: A pronoun must be locally free (= Principle B).
  - Constraints:
    - Avoid form x with meaning y.
    - Avoid form x.
    - Avoid meaning y.
- } *Markedness constraints are direction-sensitive*

## Constraints are direction-sensitive



## Constraints on referring expressions

Faithfulness constraint:

- Principle A: Avoid reflexives with a disjoint meaning  
(= Reflexives must be locally bound)

Markedness constraint:

- Referential Economy: Avoid full NPs >> Avoid pronouns >> Avoid reflexives

(Hendriks & Spenader, 2004, 2005/6)

## Children's production

Input:	FAITH	MARK	Input:	FAITH	MARK
coref. meaning	Princ. A	Ref. Econ.	disjoint meaning	Princ. A	Ref. Econ.
☞ reflexive			☞ reflexive	*!	
☞ pronoun		*!	☞ pronoun		*

Tableau 3:  
Production of coreferential meaning

Tableau 4:  
Production of disjoint meaning

## Children's comprehension

Input:	FAITH	MARK	Input:	FAITH	MARK
reflexive	Princ. A	Ref. Econ.	pronoun	Princ. A	Ref. Econ.
☞ coref.			☞ coref.		
☞ disjoint	*!		☞ disjoint		

Tableau 5:  
Comprehension of reflexive

Tableau 6:  
Comprehension of (object) pronoun

## Asymmetry

Comprehension:

reflexive → coref.  
pronoun → disjoint

Production:

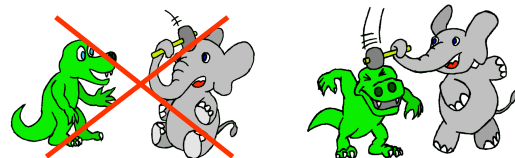
reflexive ← coref.  
pronoun ← disjoint

## The adult pattern

- For children, pronouns are ambiguous between a coreferential and a disjoint meaning.
- Why are pronouns not ambiguous for adults?
- **Hypothesis:** Adult hearers consider the point of view of the speaker, and how the speaker would have expressed the selected meaning (→ bidirectional optimization).

Here you see an elephant and an alligator.

The elephant is hitting him.



Adults: ... him, therefore not himself



## Considering the perspective of the speaker

Hearer:			Speaker:		
Input:	FAITH	MARK	Input:	FAITH	MARK
pronoun	Princ. A	Ref. Econ.	coref. meaning	Princ. A	Ref. Econ.
coref.			reflexive pronoun		*!
disjoint			Input:	FAITH	MARK
			disjoint meaning	Princ. A	Ref. Econ.
			reflexive	*!	*
			pronoun		

Mismatch !

## Today's conclusions

An optimization approach to language:

- Can be applied to phonology, morphology, syntax, semantics and pragmatics.
- Predicts potential asymmetries between production and comprehension.

## Crucial questions

- Is there additional evidence for an optimization explanation of the DPBE?
- Can we find more asymmetries in language acquisition?
- How are asymmetries resolved in adult language?

## Overview rest of course

- **Day 2:** More asymmetries in child language
  - Do late delays occur in production, too?
- **Day 3:** Early asymmetries in child language
  - Is grammar sensitive to direction of use?
- **Day 4:** Learning to optimize bidirectionally
  - How do children acquire a symmetric pattern?
- **Day 5:** Adult sentence processing
  - Are adults still sensitive to asymmetries?

## Conference: RASCAL

- **R**elating **A**symmetries between **S**peech and **C**omprehension in the **A**cquisition of **L**anguage
- Saturday, January 24 + Sunday, January 25, 2009
- Location: Hampshire Hotel Groningen
- Speakers: Eve Clark, Helen Tager-Flusberg, a.o.
- Panel discussion on Saturday